California ISO

Resource Adequacy Modeling and Program Design Working Group

February 13, 2024

Housekeeping Reminders

- This call is being recorded for informational and convenience purposes only. Any related transcriptions should not be reprinted without ISO's permission.

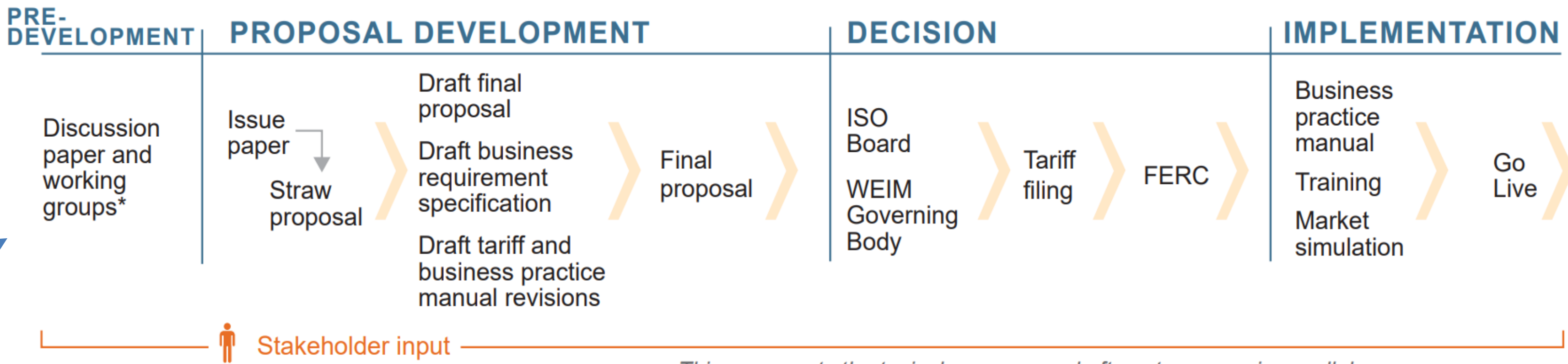
- These collaborative working groups are intended to stimulate open dialogue and engage different perspectives.

- Please keep comments professional and respectful.

Instructions for raising your hand to ask a question

- If you are connected to audio through your computer, select the raise hand icon located on the bottom of your screen.
- If you dialed in to the meeting, press #2 to raise your hand.
- Please remember to state your name and affiliation before making your comment.
- You may also send your question via chat to all panelists.

Working Group in context



This represents the typical process, and often stages run in parallel.

Stakeholder meetings, working groups and workshops may occur throughout the stakeholder process.

We are here

Agenda

Time	Topic	Speaker
9:00 - 9:10	Logistics	Isabella Nicosia
9:10 - 9:20	Welcome & Goals	Jeff McDonald
9:20 - 10:20	Review Feedback on Problem Statement 2 & 3	Jeff McDonald
10:20 - 10:30	Break	
10:30 – 10:50	CAISO Presentation: Continued Exploration of Problem Statements: Deliverability	Catalin Micsa
10:50 - 12:00	CAISO Presentation: Prior 2021 UCAP Proposal Refresher	Anja Gilbert, Abdul Mohammed-Ali, and Catalin Micsa
12:00 - 1:00	Lunch	
1:00 - 1:20	CPUC Presentation: RA Proceeding UCAP Scoping	Robert Hansen
1:20 - 2:30	Panel Discussion: Stakeholder Perspectives on Balancing Resource Counting with Availability and Performance Incentives	Panel
2:30 - 2:40	Break	
2:40 - 3:20	CAISO Presentation: Potential Modeling Frameworks	Aditya Jayam Prabhakar
3:20 - 3:30	Next Steps	Jeff McDonald

WELCOME & GOALS

RAMPD: Working group goals

Stakeholders have the opportunity to present and provide input on key components leading up to proposal development:

1. **Develop principles/goals**
   - Define and illustrate principles for resource adequacy
2. **Form initial problem statements**
   - Form problem statements reflecting stakeholder concerns
3. **Align on priorities and establish meeting cadence**
   - Balance staff & stakeholder bandwidth
4. **Refine problem statements**
   - Explore current ISO operations, functionality, processes meant to address problem statements
   - Develop methodology for analysis, define data needs
5. **Determine action items**
   - Provide a bridge between working groups and proposal development

Meeting Goals

1. ***Refine Problem Statement 2 & 3*** through review of participant comments and discussion.
2. ***Explore issues within Problem Statement 2*** and sharing relevant updates.
3. ***Level-set group's understanding of UCAP*** through
   – Presentation from CAISO staff, and
   – Overview of UCAP scoping from CPUC staff.
4. ***Understand different perspectives on counting, availability, and performance incentives*** through a panel discussion and participation from the broader working group.
5. ***Better understand modeling aspects*** through a presentation from CAISO staff and group discussion on mid term reliability modeling and visibility long term.
6. ***Discuss a straw proposal for a path forward for mature issues.***

REVIEW PROBLEM STATEMENT 2 AND 3 FEEDBACK

Problem Statement 2
Participant Comments

Theme	Stakeholders
RAAIM and UCAP	Support UCAP, No RAAIM (BAMx, CalCCA, Six Cities, PG&E, SCE Support UCAP w/ Mod RAAIM (PAO, DMM) Oppose UCAP w/ Mod RAAIM (CDWR) UCAP to SoD (CalCCA) Oppose RAAIM change only (MRP, NCPA)
Flex RA	Support assessment (BAMx, PAO, MRP, PG&E, CalCCA, PG&E, DMM, CDWR) Oppose DAME IRU/URD (MRP, Six Cities)
Outage Substitution	Support (PAO, DMM, PG&E, SCE)
Default PRM	Revisit: CalCCA, MRP, NCPA Some Opposition (CDWR, NCPA, Six Cities)

Problem Statement 3
Participant Comments

Theme	Stakeholders
BAA RSE	Assess Month Ahead RA and DA RSE (SCE) Do DA Sufficiency (CalCCA, Six Cities)

Not Problem Statement 2 or 3 Participant Comments

Theme	Stakeholders
DMM Presentation	Modeling (BAMx) Analysis (CalCCA, MRP, PG&E, SCE) Self Schedule (BAMx, Six Cities)
Incremental v. System Change	Incremental (CalCCA, Six Cities, PG&E, SCE, MRP) Systemic (CalCCA*)
Action Plan	POSO & UCAP (PAO) PRM, POSO, MT Modeling (MRP) RAAIM* (Six Cities)
Further Analysis	PRM Related (PAO, BAMx, NCPA, Six Cities) Flex RA: BAMx, SCE Margins/LOLE (PAO, CEBA, MRP) RAAIM: SCE Outage: PG&E, SCE

Not Problem Statement 2 or 3 Participant Comments (2)

Theme	Stakeholders
Modeling – Short Term	100% YA Show (MRP) Backward Looking (AReM) ISO to Estimate (CalCCA, SCE, Six Cities)
Modeling – Medium Term	Stress Test (MRP) ISO Can Access Data (CalCCA, Six Cities, SCE) Eval. Entry and Exit (CEBA) Results → Backstop Cost (PG&E)

BREAK

CAISO PRESENTATION:
EXPLORATION OF PROBLEM STATEMENT 2

Deliverability

- The deliverability assessment methodology is a CAISO methodology developed for generation interconnection study purposes pursuant to the CAISO tariff, and is used in support of RA assessments.

- The CAISO has a current initiative which is reviewing the deliverability assessment methodology to ensure deliverability requirements strike the appropriate balance between reliability and cost containment, and the reliability requirements are not unduly burdensome. https://stakeholdercenter.caiso.com/StakeholderInitiatives/Generator-deliverability-methodology-review

Summary of Generator Deliverability Final Proposal

Study of High System Need and Secondary System Need: Remove the "secondary system need" study from interconnection process deliverability studies, and monitor in planning studies

Dispatch levels: Retain current dispatch assumptions based on current exceedance methodologies, and revisit exceedance methodology values as CPUC "slice of day" methodology and related exceedance based approach evolves.

Simultaneous dispatch: Raise the 5% distribution factor threshold for 500 kV line overload constraints to 10%, which decreases the pool of generators that must wait for the identified transmission upgrades intended to mitigate the constrained path.

Study of n-2 contingencies on double circuit towers: Provide deliverability while a resource is waiting for the related n-2 deliverability upgrades to be completed if the contingency is not considered always credible in the operations horizon and does not risk cascading outages.

ADNU/LDNU guidelines: Revise the guidelines for identifying Area Deliverability Constraints (ADCs) so there is a potential for more constraints to be identified as Local Deliverability Constraints, enabling them to be addressed through the generation interconnection process.

UNFORCED CAPACITY EVALUATION METHODOLOGY

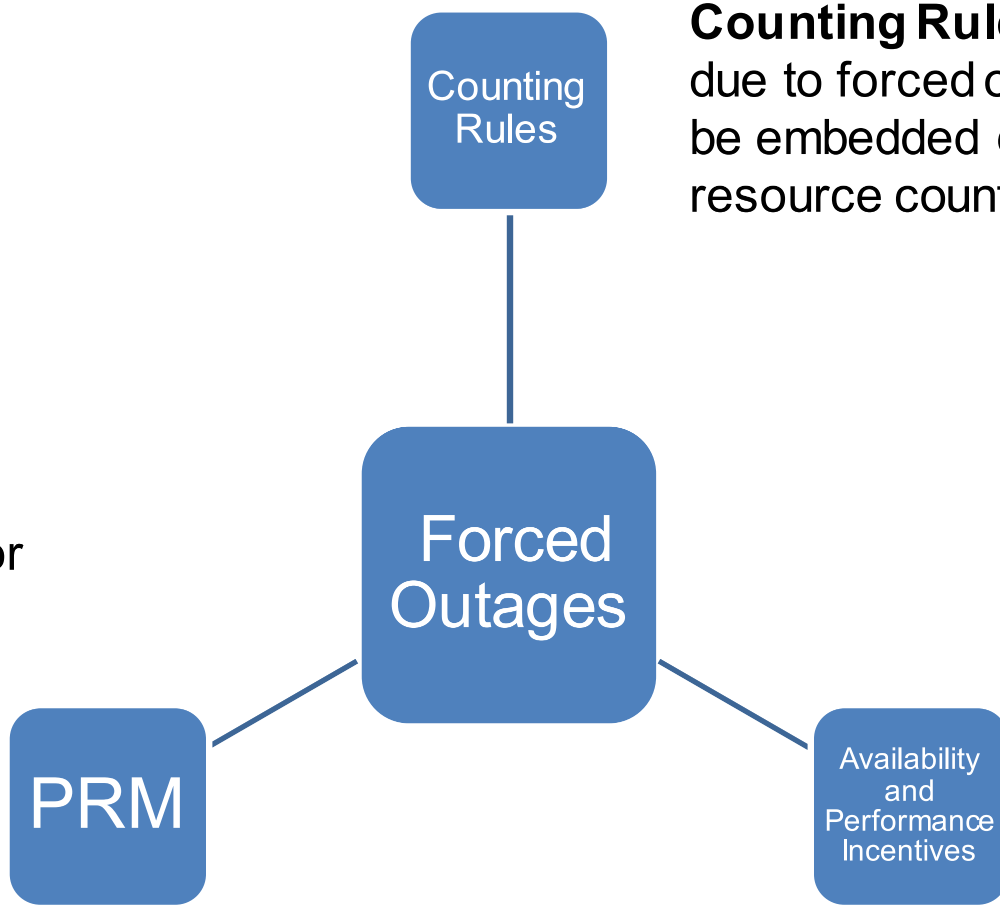
Context

This refresher on the ISO’s 2021 UCAP proposal is in response to:

- Stakeholder requests to examine UCAP in the working group;
- The CPUC’s scoping of UCAP into R.23-10-011; and
- PG&E’s inclusion of the ISO’s past UCAP proposal into R.23-10-011.

This presentation is not a recommendation, but educational background on the former ISO UCAP proposal.

Tools to Account for Forced Outages



Counting Rules: De-rates due to forced outages can be embedded directly in resource counting rules

Planning Reserve Margin (PRM): The PRM can include margin to account for the risks of forced outages on the RA fleet.

Availability & Performance Incentives: The ISO currently relies on substitution rules for resources on outage and RAAIM

Terminology: ICAP and UCAP

- Installed Capacity (ICAP) generally accounts for ambient weather conditions and represents physical generating capacity
- Unforced Capacity (UCAP) = % of ICAP, accounting for outages

Past CAISO proposal – past rationale for UCAP

- Unforced capacity evaluations can promote the procurement of the most dependable and reliable resources up front by accounting for historical unavailability in their capacity value
  - Current PRM, forced outage substitution rules, and RAAIM have proven inadequate to replace capacity on forced outage
- UCAP dynamically changes with the fleet's forced outage rate
  - Relying solely on the PRM, which has been a static value, may lead to over/under procurement if future outage rates change
  - The PRM would now only need to cover operating reserves and forecast error to the extent that resource counting sufficiently accounts for forced outages

Accounting for deliverabilty and non-availability

Two step process:

- Create DQC (deliverable qualifying capacity)
  - Conduct deliverability assessment and adjust the QC for deliverability
  - Will set the MOO for the resource
- Create NQC (net qualifying capacity)
  - Apply a non-availability factor to the DQC
    - The capacity value will still be expressed in terms of NQC

UCAP steps

1. Determine UCAP assessment hours by identify which hours fall into the top % of tightest RA supply cushion hours for each season
2. Determine hourly unavailability factors (HUF) by looking at forced and urgent outages for each UCAP assessment hours each season
3. Determine seasonal average availability factors (SAAF) using one minus the average HUFs for each season of prior year
4. Determine weighted seasonal average availability factors (WSAAF) by multiplying the prior three year SAAFs by (45% Y1, 35% Y2, 20% Y3)
5. Apply WSAAFs for each season to deliverable capacity (DQC) to determine monthly NQC (On-peak and Off-peak) values for each resource

Estimating fleet UCAP by fuel type: Natural Gas

$$\mathbf{NQC} = \sum \mathbf{Weighted\ Seasonal\ Average\ Availability\ Factors}^{\mathbf{Season}} * \boldsymbol{D}\mathbf{QC}$$

Natural gas fleet WSAAF (Peak Months)	Natural gas fleet WSAAF (Off Peak Months)	Natural Gas Fleet	On-Peak NQC	Off-Peak NQC
0.914	0.933	30,808 MWs	28,144.42 MWs	28,737.38 MWs

Note: Uses Top 20% of RA Supply Cushion. Provided as close estimate of the natural gas fleet's UCAP value, actual resource NQC values will vary

Example Resources WSSAF value by different samples of UCAP Assessment Hours

Resource	Top 20%		Top 15%		Top 10%		Top 5%		Top 1%	
Season	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak
Combined Cycle 1	0.985	0.975	0.985	0.975	0.984	0.977	0.987	0.975	0.976	1.00
Combined Cycle 2	0.899	0.867	0.896	0.860	0.886	0.851	0.869	0.827	0.856	0.768
Steamer 1	0.859	0.794	0.866	0.790	0.873	0.784	0.876	0.773	0.882	0.766
Steamer 2	0.986	0.926	0.985	0.924	0.983	0.918	0.978	0.908	0.980	0.915
CT 1	0.956	0.927	0.955	0.938	0.949	0.938	0.945	0.928	0.949	0.912
Peaker 1	0.883	0.940	0.890	0.937	0.900	0.940	0.912	0.931	0.949	0.867
Peaker 2	0.953	0.973	0.959	0.974	0.943	0.978	0.945	0.980	0.970	0.991
Total Gas Fleet	0.933	0.914	0.933	0.918	0.933	0.910	0.933	0.904	0.930	0.890
Assessment Hours per season	874	883	651	662	434	441	217	221	44	45

To get the final NQC value, multiple the WSSAF by the DQC of each resource

Former UCAP methodologies by resource type

- **Thermal and Storage:** UCAP as proposed
- **Hydro:** Longer term historical year weighted average assessment
- **Non-dispatchable resources:** if the QC methodology already accounts for forced outages, DQC=UCAP/NQC
- **Wind and Solar:** Use ELCC values as UCAP
- **Demand Response:** Use ELCC if adopted, otherwise use performance metric at the DRP level
- **QFs:** Performance relative to dispatch
- **Imports:** Consider transmission curtailments for non-frim transmission in addition to outages
- **Hybrids:** Consider dynamic limits in the HUF calculation
- **New Resources:** Start with DQC and weight early years of availability data more heavily until 3 years of data are reached

Seasons selected to calculate UCAP values can be aligned with Slice of Day

For example, the ISO could calculate seasonal UCAP values for:

- Peak Months: May – October
- Off-Peak Months: November – April

Individual local capacity obligations will change if the entire CAISO moves to UCAP

- The CAISO will continue running the local capacity studies exactly as is done today using DQC and values will publish the local capacity requirements in terms of DQC.
- At the beginning of the CAISO's local capacity study report, the CAISO will include a translation table from DQC to UCAP/NQC at the level of LSE/CPE compliance requirement. The translations will be done by TAC, as required by the CAISO Tariff.
- For each TAC, the total local UCAP/NQC requirement will be defined as follows:

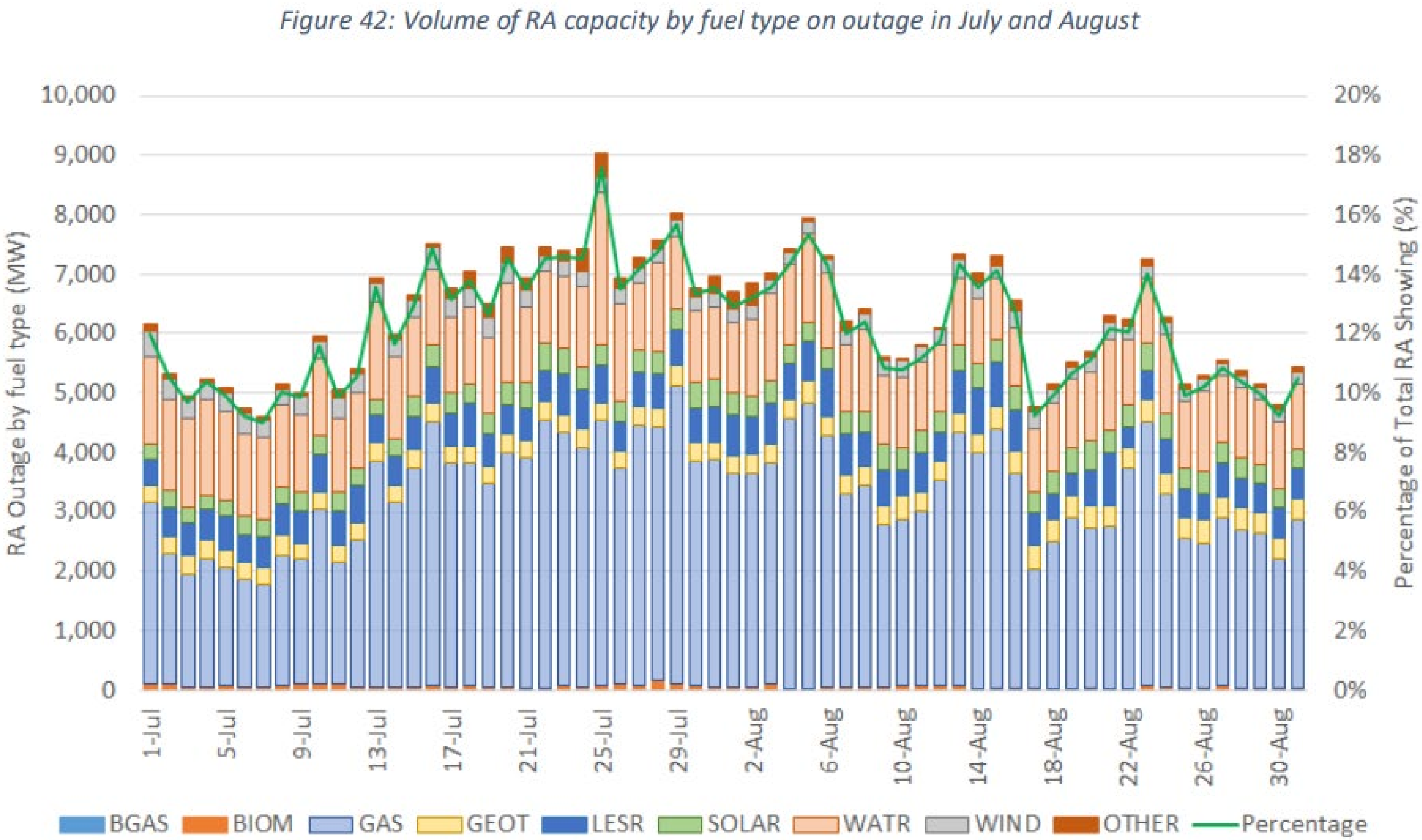
$$Total\ TAC\ UCAP\ responsability\ = \\ (\sum of\ TAC\ wide\ DQC\ requirements) X (\frac{\sum of\ TAC\ wide\ UCAP\ values}{\sum of\ TAC\ wide\ DQC\ values})$$

- The CAISO will calculate LSEs' local load-share ratio responsibility in terms of UCAP/NQC at the TAC level. As is done today, LRAs will be given their share UCAP/NQC to allocate to their LSEs/CPEs.

Challenge: Individual local capacity obligations stay the same as today if only some LRAs move to UCAP

- Local requirements are studied, calculated and allocated well before the NQC list is published for next RA Year.
- As done today they will be made public and enforced in terms of NQCs.
- Per Tariff and for technical reasons the CAISO cannot do the translation (upfront when the requirements are set and/or at the end after the showings are in) into a single TAC UCAP (as provided in the previous slide) since the UCAP is only valid for some LRAs and not for others, plus there could be different UCAP rules from one LRA to another.
- In this case (partial LRA move to UCAP), effectively the QC provided by the LRA will include the UCAP de-rate (per its own LRA rules); and while the LRA itself may be able to corroborate these UCAP values with their own provided PRM (for system wide needs), the same LRA may not be able to reduce their LSEs/CPEs local responsibility provided by the CAISO in terms of NQC.

Generation Outages by Fuel Type: July-August 2023



Source: CAISO Summer Monthly Performance Report August 2023, Figure 42

LUNCH

CPUC OVERVIEW OF RA PROCEEDING AND SCOPING

Staff Proposal for UCAP Framework

Determining and Applying Forced Outage Rates for Resource Adequacy

February 13, 2024

Presented by Robert Hansen

Senior Utilities Engineer

Resource Modeling Team

California Public Utilities Commission

Outline

- Coordination with CAISO
- Thermal Powerplants
  - EFORd from GADS
  - Additional deration for ambient temperatures
- Battery Energy Storage Systems
  - Estimating EFOR based on Curtailment Reports
- Results
- Questions

CAISO Coordination

Reconciling GADS and CAISO data and Standardizing

CAISO Coordination

- CAISO had proposed a UCAP framework previously
- CPUC and CAISO intend to coordinate developing a consistent UCAP framework for use across proceedings and markets
- There are obstacles to full implementation, including data availability and existing incentive structures

Expected Outcomes

- Better modeling of capacity availability in Resource Adequacy
- Improve alignment of policy and incentives

UCAP for Thermal Powerplants

Combustion Turbine and Combined Cycle

UCAP for Thermal Powerplants

Two Main Components:

- EFORd from GADS data
- Monthly Ambient Derates based on CAISO curtailment reports

Concerns:

- GADS data confidentiality

UCAP for Thermal Powerplants

EFORd Aggregation

- Resources are grouped into 0-25th, 25th-75th, or 75th-100th percentile ranges, based on their overall median EFORd from 2020-2022
- Capacity-weighted monthly EFORd values are calculated for each percentile group
- Not showing EFOR data today as we are aggregating it to mask confidentiality.

UCAP for Thermal Powerplants

Derates due to Ambient Temperatures

- Analyzed reported curtailments to model FORCED AMBIENT_DUE_TO_TEMPERATURE as function of temperature
- Model is applied to two unit types and 12 weather stations
- Model can be used with Climate-Informed Forecasts to predict derates in future climates
- For UCAP, used median derates under current-climate conditions for each unit type and weather station

Results with New Methodology

- Revised Slopes by Unit Type:
  - Combustion Turbine: $\beta_1 = \frac{0.138\%}{°C}$
  - Combined Cycle: $\beta_1 = \frac{0.097\%}{°C}$
  - Revised intercepts vary by Unit Type and Weather Station
- Median derated capacities in current climate across all years and weather stations:

	Original	Revised
Combustion Turbine	95.77%	98.15%
Combined Cycle	96.18%	98.70%

UCAP for Thermal Powerplants

Definition of EFORd:

$$EFORd = \frac{FOHd + EFDHd}{SH + FOHd}$$

Where

$$FOHd = Forced\ Outage\ Hrs\ during\ Demand$$

$$EFDHD = Equivalent\ Forced\ Outage\ Hrs\ during\ Demand$$

$$= EFDH - EFDHRS$$

$$SH = Service\ Hrs$$

$$EFDH = Equivalent\ Force\ Outage\ Hrs$$

$$= \frac{Deration\ Hrs \times Size\ of\ Reduction}{Net\ Maximum\ Capacity}$$

$$EDFHRS = \frac{Deration\ Hrs\ during\ Reserve\ Shutdowns \times Size\ of\ Reduction}{Net\ Maximum\ Capacity}$$

Updated Methodology for Derating Thermal Powerplants due to Ambient Temperature

Changes to the originally proposed derating

History of this proposal and objective of this presentation

- Staff presented a methodology for derating thermal powerplants each hour based on hourly temperature in March 2023
- Stakeholders submitted comments and questions, which resulted in very helpful dialogue and led to an improved methodology.

Revised methodology:

- Zero curtailment (i.e., full capacity) is now assumed for unreported hours
- Apply multilinear regression rather than single variable regressions in two-steps
  - Create boolean variables to define categories
  - Each weather station becomes a variable for regression which can both be either 0 or 1
  - Allows more data to be included in analysis
  - Each unit type is analyzed separately, yielding different best-fit curves

Updated Methodology

For each unit type, we find the least-squares optimal regression parameters to fit the model:

$$D_i = \beta_1 T_i^* + \beta_{3.1} W_1 + \beta_{3.2} W_2 + \cdots + \beta_{3.n} W_n + \beta_4$$

D_i	is the reported or imputed derate percentage for observation i
T_i^*	is the recorded temperature of the nearest weather station at the time of observation i normalized for resource
W_j	is the j^{th} Boolean variable indicating the weather station closest to the resource associated with observation i, with exactly one of n
β_k	is a linear regression parameter applied to the k^{th} of the $2+n$ variables

Updated Methodology

The regression parameter for temperature is then applied to piecewise-linear model for each class, consisting of a weather station and a unit type

$$\widehat{D}_i = \begin{cases} 100\% & |T_i \leq T_0 \\ 100\% - \beta_1(T_i - T_0) & |T_i > T_0 \end{cases}$$

This aspect of the model is unchanged from the previous version.

Updated Methodology

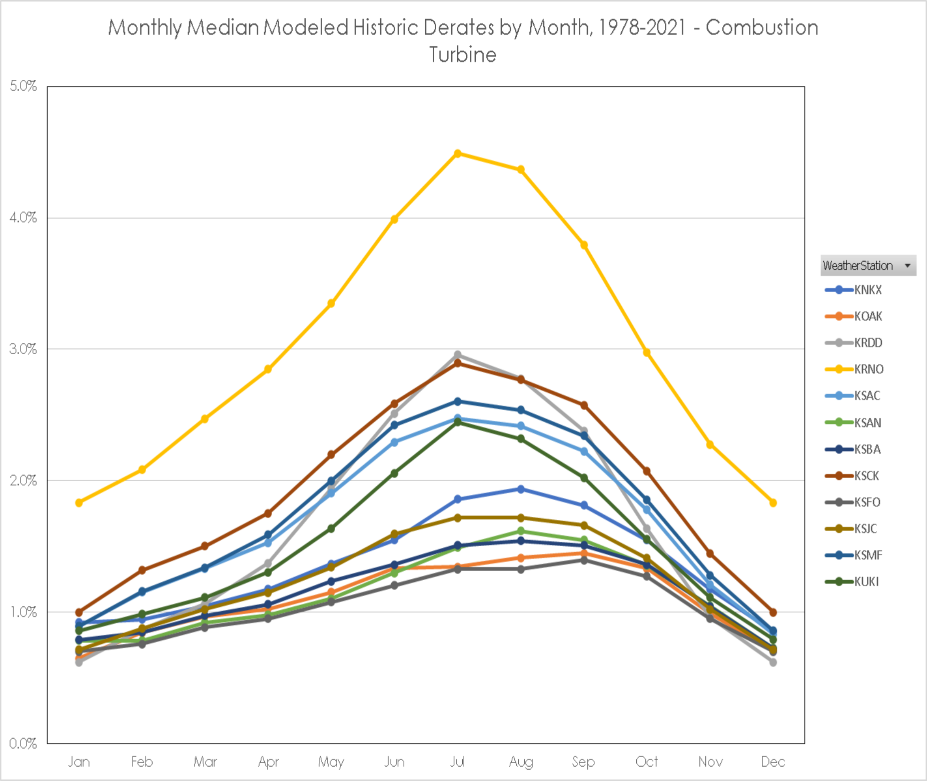
- The derate model was applied to the current-climate weather year to produce hourly derations for each unit type and weather station
- Monthly outage rates are the median hourly deration percentage due to ambient temperature throughout the month

UFOR for Thermal Resources

Results

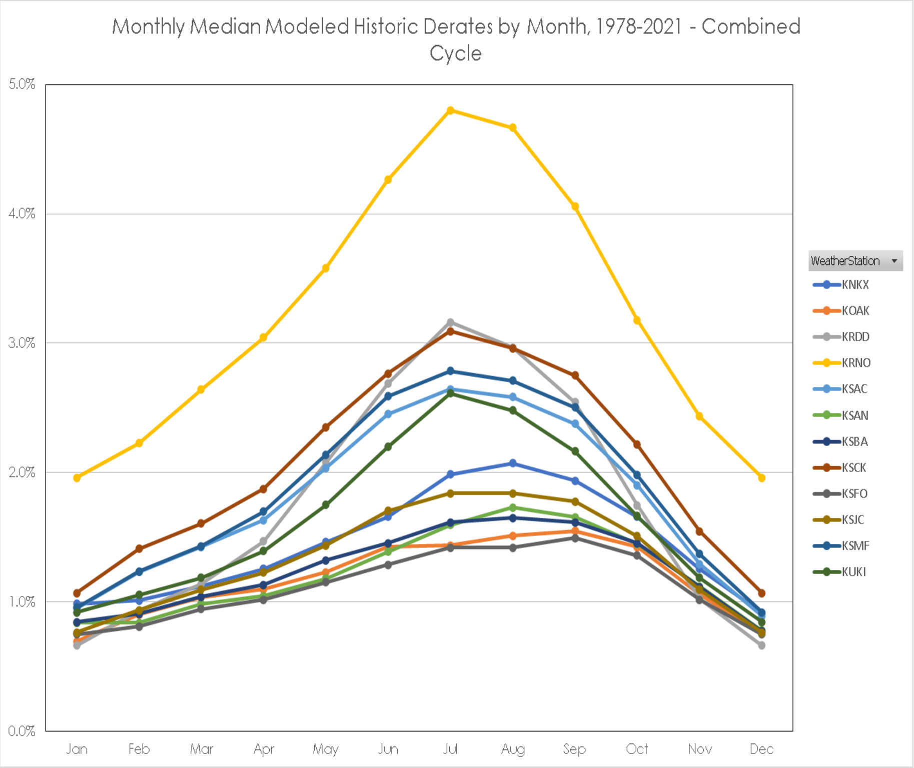
Ambient Deration – Combustion Turbine

	Weather Station ID											
Month	KNKX	KOAK	KRDD	KRNO	KSAC	KSAN	KSBA	KSCK	KSFO	KSJC	KSMF	KUKI
Jan	0.92%	0.65%	0.62%	1.83%	0.89%	0.78%	0.79%	1.00%	0.70%	0.72%	0.89%	0.86%
Feb	0.95%	0.84%	0.87%	2.08%	1.15%	0.78%	0.85%	1.32%	0.76%	0.88%	1.16%	0.99%
Mar	1.05%	0.97%	1.06%	2.47%	1.33%	0.92%	0.97%	1.50%	0.88%	1.02%	1.34%	1.11%
Apr	1.17%	1.03%	1.37%	2.85%	1.53%	0.98%	1.06%	1.75%	0.95%	1.15%	1.59%	1.30%
May	1.37%	1.15%	1.94%	3.35%	1.90%	1.10%	1.24%	2.20%	1.08%	1.34%	2.00%	1.64%
Jun	1.55%	1.33%	2.51%	3.99%	2.29%	1.30%	1.36%	2.59%	1.20%	1.59%	2.42%	2.06%
Jul	1.86%	1.35%	2.96%	4.49%	2.48%	1.49%	1.51%	2.89%	1.33%	1.72%	2.61%	2.45%
Aug	1.94%	1.41%	2.78%	4.37%	2.42%	1.62%	1.54%	2.77%	1.33%	1.72%	2.54%	2.32%
Sep	1.81%	1.45%	2.38%	3.80%	2.22%	1.55%	1.51%	2.57%	1.40%	1.66%	2.34%	2.02%
Oct	1.55%	1.33%	1.63%	2.97%	1.78%	1.36%	1.36%	2.07%	1.27%	1.41%	1.85%	1.56%
Nov	1.17%	0.99%	0.96%	2.28%	1.21%	1.05%	1.04%	1.45%	0.95%	1.02%	1.28%	1.11%
Dec	0.85%	0.71%	0.62%	1.83%	0.83%	0.73%	0.72%	1.00%	0.70%	0.72%	0.86%	0.79%



Ambient Deration – Combined Cycle Blocks

	Weather Station ID											
Month	**KNKX**	**KOAK**	**KRDD**	**KRNO**	**KSAC**	**KSAN**	**KSBA**	**KSCK**	**KSFO**	**KSJC**	**KSMF**	**KUKI**
Jan	0.99%	0.69%	0.66%	1.96%	0.95%	0.84%	0.85%	1.07%	0.75%	0.76%	0.96%	0.92%
Feb	1.01%	0.90%	0.93%	2.23%	1.23%	0.84%	0.91%	1.41%	0.81%	0.94%	1.24%	1.05%
Mar	1.12%	1.04%	1.14%	2.64%	1.43%	0.99%	1.04%	1.61%	0.94%	1.09%	1.43%	1.19%
Apr	1.25%	1.10%	1.47%	3.04%	1.63%	1.05%	1.13%	1.87%	1.02%	1.23%	1.70%	1.39%
May	1.46%	1.23%	2.08%	3.58%	2.04%	1.18%	1.32%	2.35%	1.15%	1.44%	2.14%	1.75%
Jun	1.66%	1.43%	2.69%	4.26%	2.45%	1.39%	1.46%	2.76%	1.29%	1.70%	2.59%	2.20%
Jul	1.99%	1.44%	3.16%	4.80%	2.65%	1.60%	1.61%	3.09%	1.42%	1.84%	2.79%	2.61%
Aug	2.07%	1.51%	2.97%	4.67%	2.58%	1.73%	1.65%	2.96%	1.42%	1.84%	2.71%	2.48%
Sep	1.94%	1.55%	2.54%	4.06%	2.38%	1.66%	1.61%	2.75%	1.49%	1.78%	2.50%	2.16%
Oct	1.66%	1.43%	1.75%	3.18%	1.90%	1.45%	1.46%	2.22%	1.36%	1.51%	1.98%	1.66%
Nov	1.25%	1.06%	1.02%	2.43%	1.29%	1.12%	1.11%	1.55%	1.02%	1.09%	1.37%	1.19%
Dec	0.91%	0.76%	0.66%	1.96%	0.89%	0.78%	0.77%	1.07%	0.75%	0.76%	0.92%	0.85%



UFOR from EFORd and Ambient Derates

- UFOR values evaluated on a monthly basis for each resource
- Each resource would be assigned an ambient derate based on its unit type and nearest weather station, and an EFORd category based on its historic performance
- Each resource's UFOR values are the sum of the associated EFORd + median ambient deration multiplied by the resource's capacity for each month.

UCAP for Battery Energy Storage Systems

Estimating EFOR from CAISO curtailment reports, not GADS

UFOR for Battery Energy Storage Systems

Remaining Issues

Remaining Issues for Storage UCAP

- EFOR Denominator
  - Where to find or how to estimate Reserve Shutdowns and Charging Hours?
  - Assume 4 hours or other fixed charging time each day?
  - Expect EFOR to increase with any change.
- Cause Code Equivalency
  - Do any curtailments marked "Planned" count toward Forced Outage Rate?
  - Which Nature-of-Work values should be included in EFOR numerator and denominator?
- Resource Aggregation
  - Is aggregation necessary, or are resource-level monthly EFOR preferrable?

Remaining Issues for Storage UCAP

- All results are preliminary
- We request stakeholder feedback on these issues and any other concerns

UFOR for Battery Energy Storage Systems

Methodology

UCAP for Battery Energy Storage Systems

- Preliminary Approach and Results
- GADS database does not yet include battery resources
- As alternative, we propose developing UCAP values based on CAISO's Prior Trade Day Curtailment Reports
- Key Limitations:
  - Storage resources are new, so only a few years of data is available
  - Curtailment reports don't include data on reserve shutdowns or charging hours

Curtailment Reports vs. GADS

Comparing GADS vs. CAISO data:

- GADS outages include a Unit Code associated with the resource, Event Type, and Cause Code indicating the reason for the outage
- CAISO curtailments are reported by Resource ID, Outage ID, Outage Type, and Nature-of-Work
- 100s of cause codes vs. 10s of combinations of Outage Type and Nature-of-Work
- Mapping CAISO curtailments to GADS outages is not straightforward

GADS Cause Codes for Combined Cycle

- PLANT_TROUBLE
- NEW_GENERATOR_TEST_ENERGY
- TRANSITIONAL_LIMITATION
- ENVIRONMENTAL_RESTRICTIONS
- METERING_TELEMETRY
- UNIT_TESTING
- SHORT_TERM_USE_LIMIT_REACHED
- RIMS_TESTING
- ANNUAL_USE_LIMIT_REACHED
- MONTHLY_USE_LIMIT_REACHED
- TECHNICAL_LIMITATIONS_NOT _IN_MARKET_MODEL
- OTHER_USE_LIMIT_REACHED
- RIMS_OUTAGE
- UNIT_SUPPORTING_STARTUP
- RTU_RIG
- ICCP

CAISO Curtailment Natures-of-Work

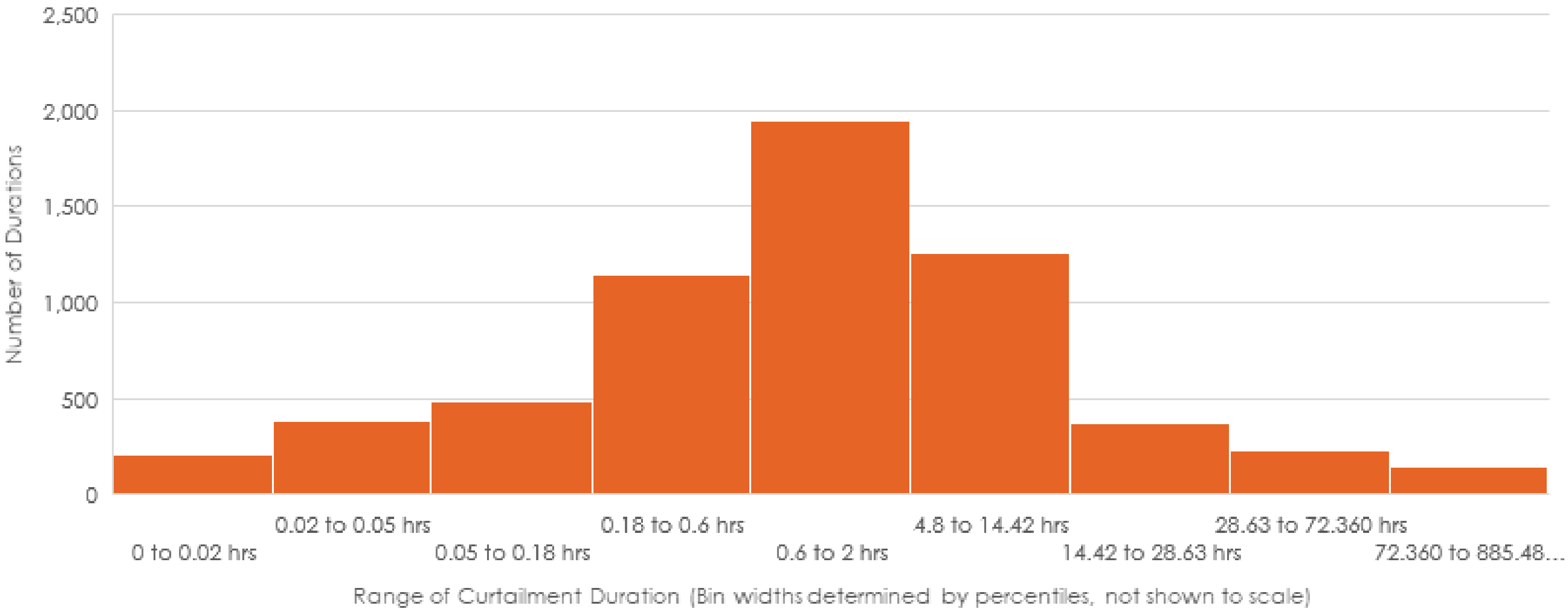
Forced Outages:

- AMBIENT_DUE_TO_FUEL_INSUFFICIENCY
- AMBIENT_DUE_TO_TEMP
- AMBIENT_NOT_DUE_TO_TEMP
- ANNUAL_USE_LIMIT_REACHED
- ENVIRONMENTAL_RESTRICTIONS
- ICCP
- METERING_TELEMETRY
- MONTHLY_USE_LIMIT_REACHED
- NEW_GENERATOR_TEST_ENERGY
- OTHER_USE_LIMIT_REACHED
- PLANT_MAINTENANCE
- PLANT_TROUBLE
- RIMS_OUTAGE
- RIMS_TESTING
- RTU_RIG
- SHORT_TERM_USE_LIMIT_REACHED
- TECHNICAL_LIMITATIONS_NOT_IN_MARKET_MODEL
- TRANSITIONAL_LIMITATION
- TRANSMISSION_INDUCED
- UNIT_SUPPORTING_STARTUP
- UNIT_TESTING

Planned Outages:

- AMBIENT_DUE_TO_FUEL_INSUFFICIENCY
- AMBIENT_DUE_TO_TEMP
- AMBIENT_NOT_DUE_TO_TEMP
- ENVIRONMENTAL_RESTRICTIONS
- METERING_TELEMETRY
- NEW_GENERATOR_TEST_ENERGY
- PLANT_MAINTENANCE
- PLANT_TROUBLE
- RIMS_OUTAGE
- RTU_RIG
- SHORT_TERM_USE_LIMIT_REACHED
- TRANSITIONAL_LIMITATION
- TRANSMISSION_INDUCED
- UNIT_SUPPORTING_STARTUP
- UNIT_TESTING

Number of Curtailments by Duration (All Causes)



Selecting Curtailments

Natures-of-Work Included (when paired with Outage Type “FORCED”):

- PLANT_TROUBLE
- NEW_GENERATOR_TEST_ENERGY
- TRANSITIONAL_LIMITATION
- ENVIRONMENTAL_RESTRICTIONS
- METERING_TELEMETRY
- UNIT_TESTING
- SHORT_TERM_USE_LIMIT_REACHED
- RIMS_TESTING
- ANNUAL_USE_LIMIT_REACHED
- MONTHLY_USE_LIMIT_REACHED
- TECHNICAL_LIMITATIONS_NOT_IN_MARKET_MODEL
- OTHER_USE_LIMIT_REACHED
- RIMS_OUTAGE
- UNIT_SUPPORTING_STARTUP
- RTU_RIG
- ICCP

Selecting Curtailments

Dates:

- Only used full months between July 2021 and November 2023
- Resources with startup dates after July 2021 truncated to first full month

Approach to Estimating EFOR

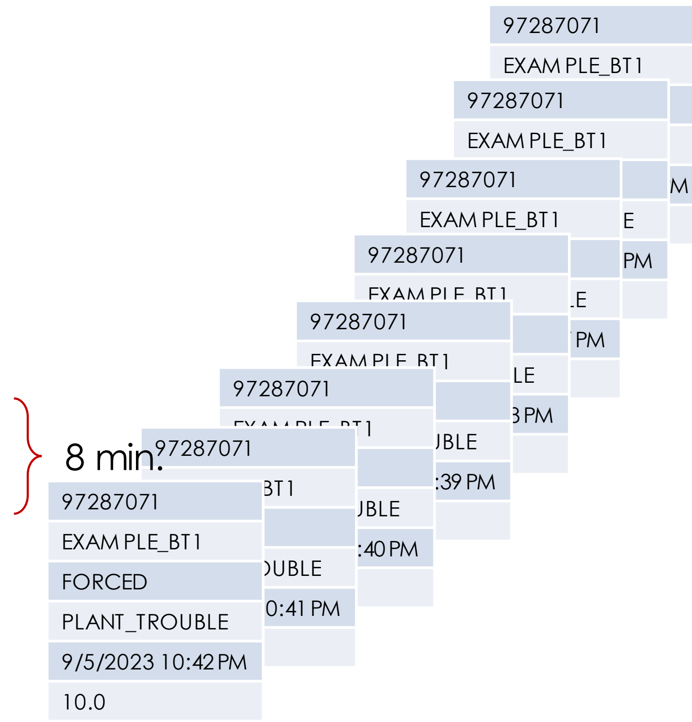
1. Download all available CAISO Prior Trade-Day Curtailment Reports
2. Merge all reports into a single table
3. Join curtailments table with Master Capability List to identify resource types and apply Net Dependable Capacities
4. Filter curtailments for battery resources
5. Filter curtailments for "FORCED" outage types and selected natures-of-work

Approach to Estimating EFOR

6. Expand table into discrete time blocks of equal duration based on curtailment start and end times
7. Remove duplicate curtailment records (same Outage MRID and time)
8. Calculate disaggregated Equivalent Forced Deration Hours as Curtailment MW * time block in hours / Net Dependable Capacity
9. Aggregate by Resource ID and Month
10. Calculate Equivalent Forced Outage Rate as EFDH / (Hours in Month – Planned Outage Hours)

Curtailment Time Block Expansion

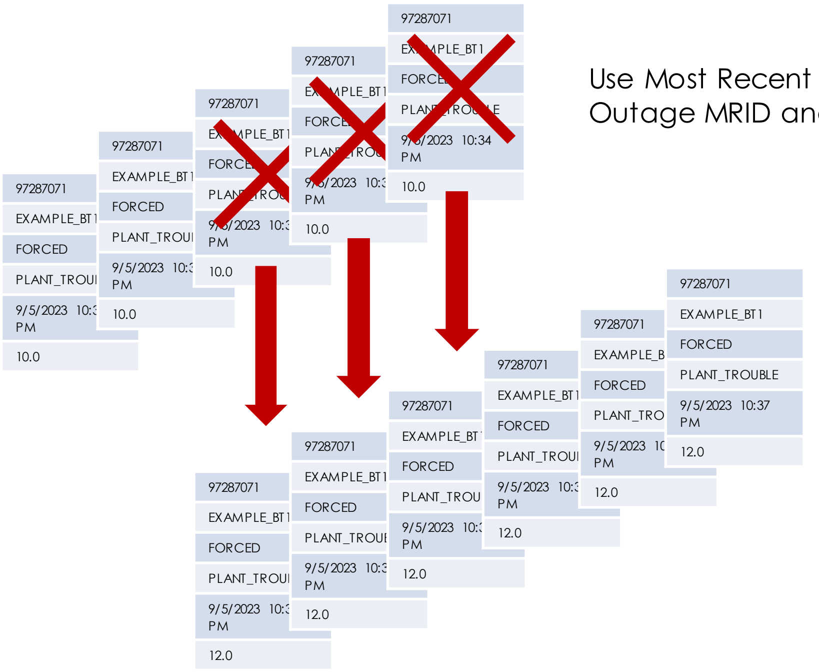
FIELD	VALUE
OUTAGE MRID	987654321
RESOURCE ID	EXAMPLE_BT1
OUTAGE TYPE	FORCED
NATURE OF WORK	PLANT_TROUBLE
CURTAILMENT START DATE TIME	9/5/2023 10:35 PM
CURTAILMENT END DATE TIME	9/5/2023 10:43 PM
CURTAILMENT MW	10.0



Handling Overlapping Curtailment Reports

FIELD	VALUE
OUTAGE MRID	987654321
RESOURCE ID	EXAMPLE_BT1
OUTAGE TYPE	FORCED
NATURE OF WORK	PLANT_TROUBLE
CURTAILMENT START DATE TIME	9/5/2023 10:30 PM
CURTAILMENT END DATE TIME	9/5/2023 10:36 PM
CURTAILMENT MW	10.0

FIELD	VALUE
OUTAGE MRID	987654321
RESOURCE ID	EXAMPLE_BT1
OUTAGE TYPE	FORCED
NATURE OF WORK	PLANT_TROUBLE
CURTAILMENT START DATE TIME	9/5/2023 10:32 PM
CURTAILMENT END DATE TIME	9/5/2023 10:38 PM
CURTAILMENT MW	12.0

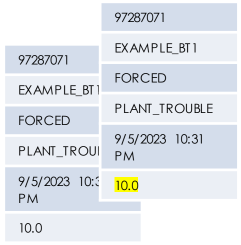


Use Most Recent Report for each Outage MRID and Datetime

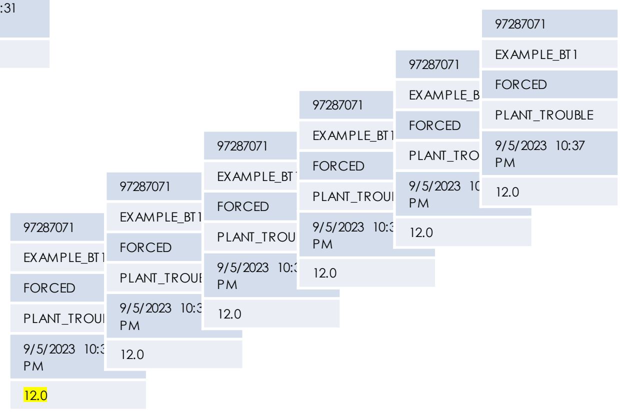
Handling Overlapping Curtailment Reports

FIELD	VALUE
OUTAGE MRID	987654321
RESOURCE ID	EXAMPLE_BT1
OUTAGE TYPE	FORCED
NATURE OF WORK	PLANT_TROUBLE
CURTAILMENT START DATE TIME	9/5/2023 10:30 PM
CURTAILMENT END DATE TIME	9/5/2023 10:36 PM
CURTAILMENT MW	10.0

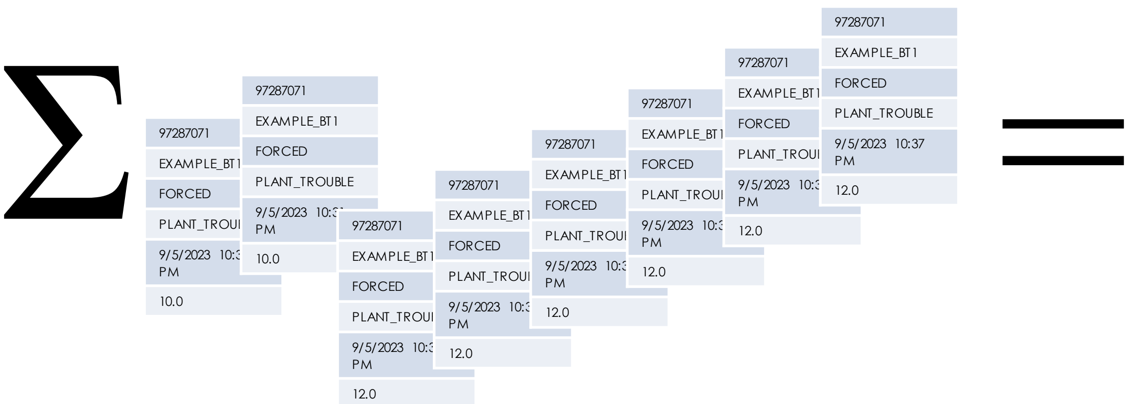
FIELD	VALUE
OUTAGE MRID	987654321
RESOURCE ID	EXAMPLE_BT1
OUTAGE TYPE	FORCED
NATURE OF WORK	PLANT_TROUBLE
CURTAILMENT START DATE TIME	9/5/2023 10:32 PM
CURTAILMENT END DATE TIME	9/5/2023 10:38 PM
CURTAILMENT MW	12.0



Curtailment MW may vary throughout duration



Aggregating Curtailment Time Blocks



FIELD	VALUE
OUTAGE MRID	987654321
RESOURCE ID	EXAMPLE_BT1
OUTAGE TYPE	FORCED
NATURE OF WORK	PLANT_TROUBLE
CURTAILMENT DURATION	8 minutes
EFDH	0.0153 hours

Example Net Dependable Capacity = 100 MW

EFDH = (10 MW * 2 minutes + 12 MW * 6 minutes) / 100 MW * (1hr / 60 minutes)

Calculating Monthly EFOR

GADS Definition: $EFOR = \frac{FOH+EFDH}{FOH+SH+Sync\ Hrs+Pumping\ Hrs+EFDHRS}$

$$FOH = Forced\ Outage\ Hrs$$

$$EFDH = Equivalent\ Forced\ Deration\ Hrs = \frac{Deration\ Hrs \times Size\ of\ Reduction}{Net\ Maximum\ Capacity}$$

$$SH = Service\ Hrs$$

$$EFDHRS = Equivalent\ Forced\ Deration\ Hrs\ during\ Reserve\ Shutdowns$$

Applied Approximation: $\frac{\frac{Deration\ Hrs \times Size\ of\ Reduction}{Net\ Dependable\ Capacity}}{Month\ Hrs - Equivalent\ Planned\ Deration\ Hrs}$

Limitations and Notes

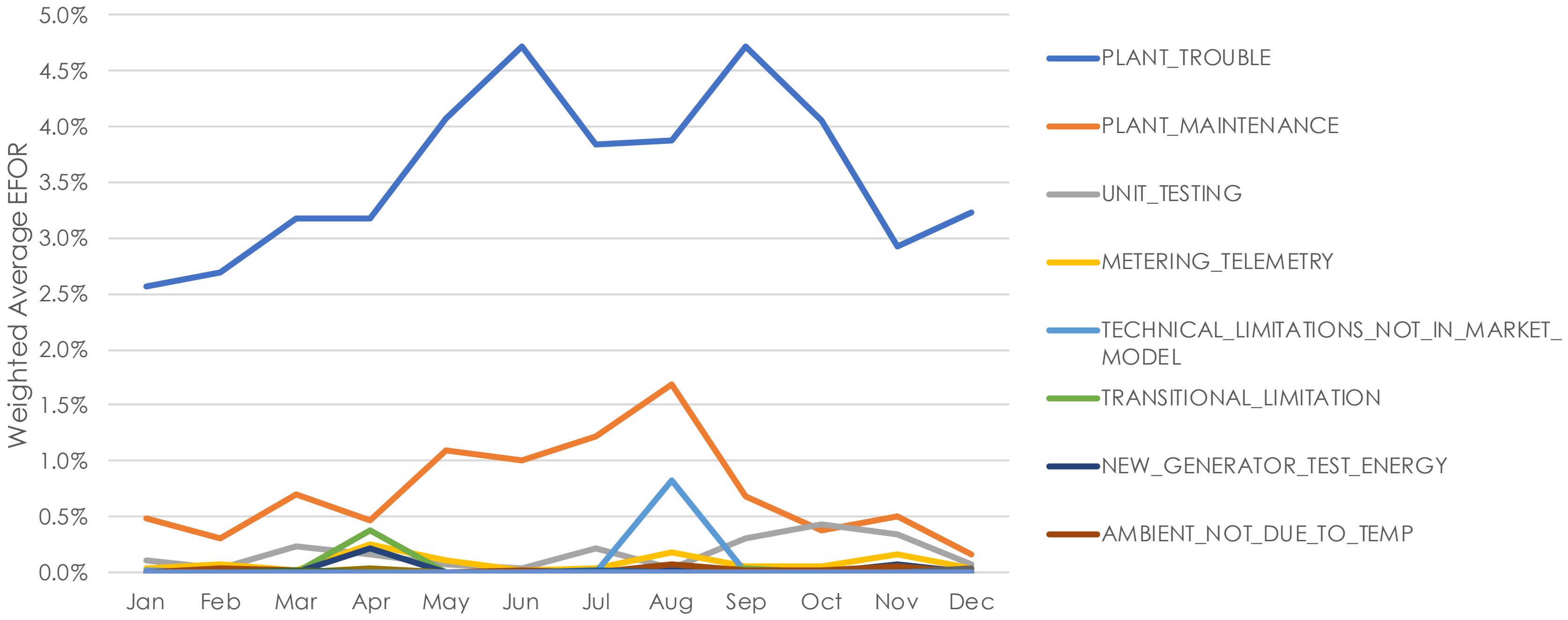
- Reserve shutdown and service hours are unknown
- Charging hours are unknown
- Forced Outage Hours = Equivalent Forced Deration Hours when Size of Deration = Net Maximum Capacity (i.e., 100% deration)

UFOR for Battery Energy Storage Systems

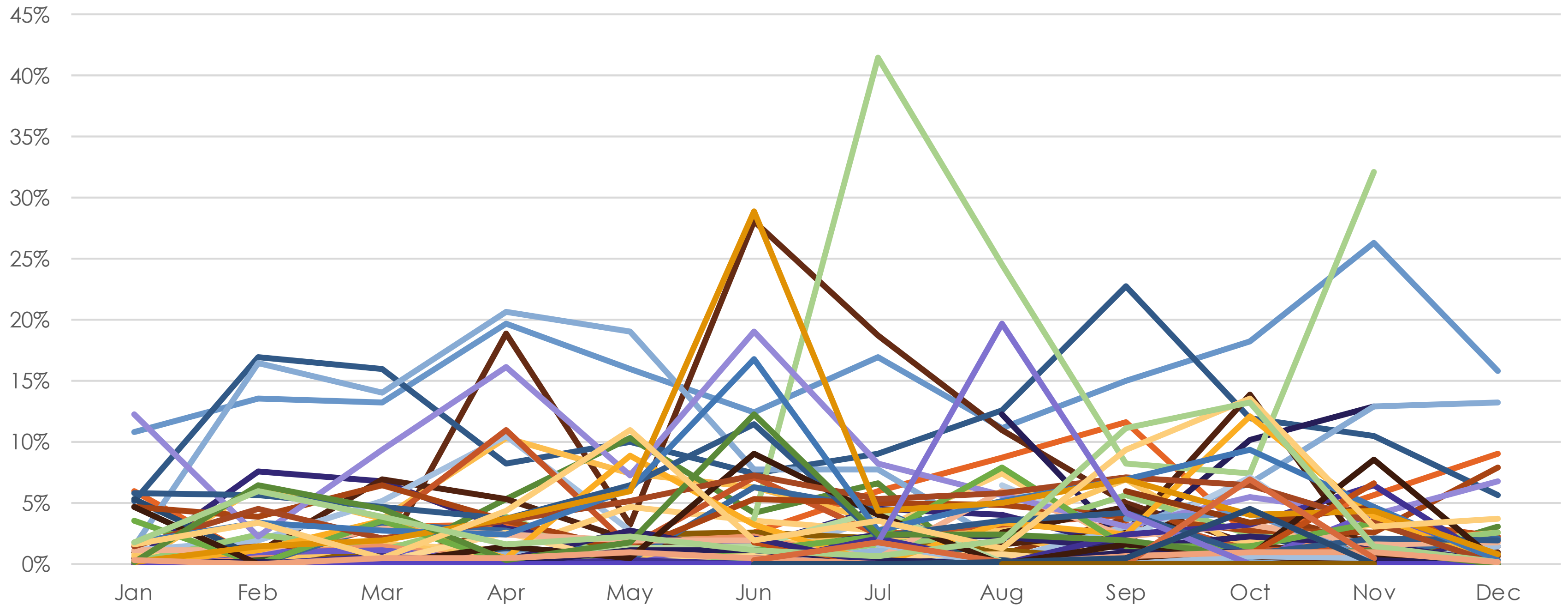
Results

California Public Utilities Commission

Capacity-Weighted Average EFOR by Nature-of-Work and Month



EFOR by Resource and Month



Conclusions

- Wide variation in EFOR by resource
- Seasonal variation in EFOR visible with higher outage rates in summer than winter
- EFOR values lower than expected due to issues in calculating denominator

UFOR for Battery Energy Storage Systems

Reiterating Remaining Issues

Remaining Issues for Storage UCAP

- EFOR Denominator
  - Where to find or how to estimate Reserve Shutdowns and Charging Hours?
  - Assume 4 hours or other fixed charging time each day?
  - Expect EFOR to increase with any change.
- Cause Code Equivalency
  - Do any curtailments marked "Planned" count toward Forced Outage Rate?
  - Which Nature-of-Work values should be included in EFOR numerator and denominator?
- Resource Aggregation
  - Is aggregation necessary, or are resource-level monthly EFOR preferrable?

Remaining Issues for Storage UCAP

- All results are preliminary
- We request stakeholder feedback on these issues and any other concerns

Questions?

For more information:

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PANEL: BALANCING RESOURCE COUNTING WITH AVAILABILITY & PERFORMANCE INCENTIVES

Panel: Balancing Resource Counting with Availability & Performance Incentives

- CalCCA, Lauren Carr
- CESA, Perry Servedio
- PG&E, Peter Griffes
- Six Cities, Meg McNaul
- WPTF, Carrie Bentley

Resource Planning and Procurement: Concepts for Addressing Current Challenges

Cities of Anaheim, Azusa, Banning, Colton,
Pasadena, and Riverside, California

California Independent System Operator Corporation

Resource Adequacy Modeling and Program Design Working Group

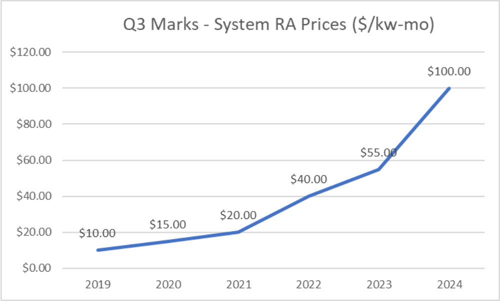
February 13, 2024

- Municipally-owned and operated electric utilities
- Local regulatory authorities are the Cities' respective City Councils
- Located in the CAISO BAA and comprise approximately 3% of load
- Several of the Cities own and operate generation resources
- All cities engage in procurement of generation and transmission to serve loads
- All have targeted a 15% Planning Reserve Margin
  - Adopted by local regulatory authority or applied as management policy
- Generally use CAISO default qualifying capacity criteria absent unique circumstances
  - Do not include demand response resources in portfolios

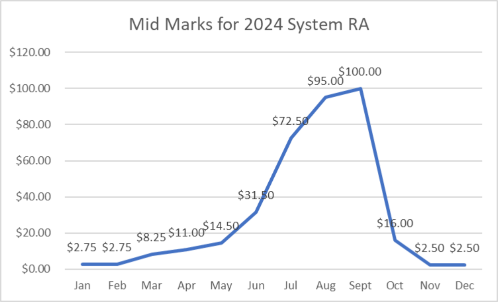
2022 Peak Loads (MW)	
Anaheim	500
Azusa	71
Banning	52
Colton	93
Pasadena	319
Riverside	648

Current Challenges in Resource Procurement

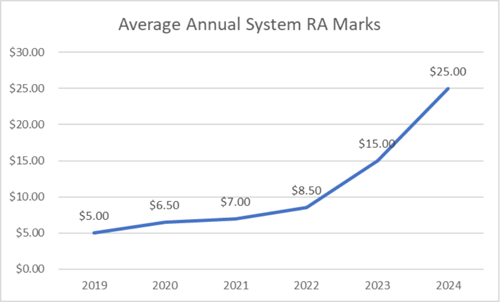
- High penetration of RPS-eligible capacity creates increasing reliability challenges in the CAISO BAA and west
- Increased competition for capacity across the western region
- Dramatically increasing prices for both renewable capacity and capacity eligible to meet RA availability obligations
  - Quoted prices are multiples of prevailing prices from several years ago



Source: City internal data

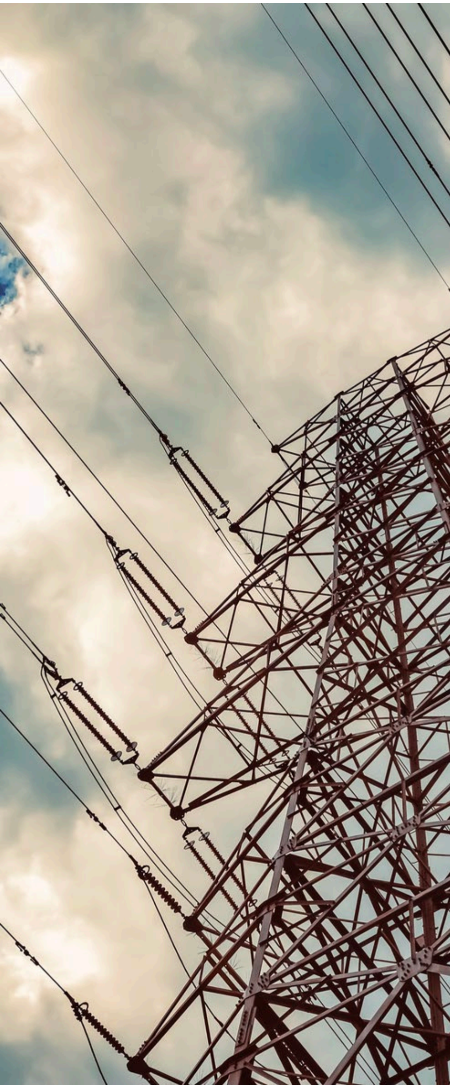


Source: Broker data



Source: Broker data

- Substantial decline in responses to RFPs for RA capacity from resources eligible to meet CAISO RA requirements
  - No responses in some cases



Factors Intensifying Procurement Challenges

- Substantially increased backlog in the CAISO interconnection queue
  - 354 GW (Cluster 15) plus 188 GW (pre-Cluster 15) of projects
- CAISO requirements
  - Limitations and requirements for full or partial capacity deliverability status for internal RA resources
  - Limitations on availability of Maximum Import Capability (MIC) required to qualify import RA resources
  - Potential limitations on City-developed resources proposed as part of interconnection reforms (i.e., CAISO caps resources eligible for study)
- Continuing supply chain problems impacting progress of new resources
- Removal/retirement of RA resources from market
- Bottom line – LSEs are unable to build, buy, or import RA-eligible capacity at a reasonable cost at this time

Conceptual Proposals

1. Recognition of load reducing capability for in-front-of-meter local battery resources
   - Batteries located in front of the retail meter and capable of participating as energy-only resources in the CAISO markets as part of the CEC's Demand Side Grid Support Program
   - LSEs would not receive financial compensation from the DSGS program, but rather be allowed to reduce forecasted monthly peak loads by the measured and verified 4-hour continuous energy output of the battery
2. Recognition of locally developed projects to satisfy RA requirements
   - Allow LSEs to meet some percent of RA needs (for example, 15% to 20%, but not to exceed minimum load in a defined local area) using locally developed projects within service territory
   - Would not require CAISO deliverability status
   - Would meet must-offer and CAISO telemetry requirements
3. Establishment of listings for "Conditional RA" availability
   - RA-eligible resources that are not included in month-ahead showings
   - Provided on voluntary basis and subject to recission if not used by another LSE
   - Provide compensation to supplying LSE
   - Could offset deficiencies by other LSEs
4. Daily distribution of capacity among internal RA resources
   - Modification of the monthly RA showing process to allow different RA values for internal RA resources for different days of the month
   - Subject to the sum of the RA values for each day satisfying the monthly RA requirement for the LSE submitting the showing

Questions?

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BREAK

MODELING FRAMEWORK

Modeling Approach Shared with Working Group on 11/1

The world is changing, more VERs, probabilistic modeling of risks necessary. RA modeling will be around three time horizons to answer these specific questions:

Question	Sufficiency Analysis of	RA Timeframe	What are we looking for?
Are the year ahead RA showings adequate?	RA Showings	Year Ahead	Does the ISO BA have a MW shortfall or excess? Approach: Similar to Summer Assessment but with only RA showings; since year-ahead showing requirements are only 90% of total requirements, develop assumptions for last 10%
Is the current level of authorized procurement and contracted capacity sufficient?	Existing installed capacity + authorized procurement	Years 2-4	Do we have enough collectively and who needs to bring more? Approach: LOLE and ELCC by resource types
Is the LT plan producing resource adequate portfolios to meet reliability targets?	Resource plans by consolidating information from all IRPs	Years 5-10	To determine if the ISO BAA has sufficient resources for years 5 to 10. Approach: Find a way to translate that to PRM, ELCC for all resources, LOLE hours, etc.

RELIABILITY VISIBILITY: LONG-TERM

Background: Long term study is an assessment of whether the long-term plan meets reliability targets

- In the 2023 Summer Loads and Resources assessment, CAISO presented a long-term analysis of the 2021 CPUC Preferred System Plan

	2023	2024	2025	2026	2032
Peak Managed Load (MW)					
2022 IEPR Planning Scenario	46,829	47,475	47,987	48,487	53,066
2021 IEPR Mid-Mid 3-3 Scenario	46,727	47,325	47,749	48,190	51,444
Changes	102	150	238	297	1,622
Results of PSP with 2022 IEPR Forecast					
LOLE	0.064	0.026	0.134	0.142	0.438
Surplus or shortfall in effective capacity to achieve the 1 -in-10 planning target	Surplus of 421 MW	Surplus of 1,313 MW	Shortfall of 1,294 MW	Shortfall of 1,412 MW	Shortfall of 2,382 MW
Results of PSP with 2022 IEPR Forecast with High Hydro Condition [a]					
LOLE	0.024				
Surplus or shortfall in effective capacity to achieve the 1 -in-10 target performance	Surplus of 1,761 MW				
Changes of surplus in effective capacity (MW) [b]	1,340				
Results of PSP with 2021 IEPR Forecast					
LOLE	0.064	0.018	0.130	0.126	0.142
Surplus or shortfall in effective capacity to achieve the 1 -in-10 target performance	Surplus of 531 MW	Surplus of 1,493 MW	Shortfall of 1,029 MW	Shortfall of 1,146 MW	Shortfall of 509 MW
Changes of surplus or shortfall (MW) [c]	-110	-180	265	266	1,873

[a] *The high hydro case has hydro availability similar to 1997-1998 season, which is the highest among the 1998-2017 historical data the CPUC provided.*

[b] *From the case with 2022 IEPR and normal hydro to that with 2022 IEPR and high hydro.*

[c] *From the case with 2021 IEPR and normal hydro to that with 2022 IEPR and normal hydro.*

The ISO's stochastic model will be updated with long term resource planning information

Resources modeled	Study methodology	Outputs
• All installed RA-eligible capacity • Authorized procurement • IRP resources • Resource retirements	• Probabilistic assessments (stochastic production cost simulation models)	• LOLE • Capacity shortfall or surplus to get to 0.1 LOLE • ELCC by resource types by year

Long-term survey - for discussion

- Information that CAISO may need –
  - projected estimates of new capacity additions by fuel type
  - resource retirement assumptions

Summary	2028	2029	2030	2031	2032	2033
Annual Peak Load (MW)						
PRM (%)						
Total contracted capacity for peak month (MW)						
	yes, if sum >=requirement					

New Resources from your resource plans

Resource ID	CAISO queue number	Resource Name	Installed Capacity	COD	Fuel Type	NQC	Deliverability	Location	Area
Resource1									
Resource2									
Resource3									
Resource4									
Resource5									
Resource6									
Resource7									
Resource8									
Resource9									
Resource10									
Resource11									
Resource12									
Resource13									
Resource14									
Resource15									
etc.									

Example

CAISO appreciates feedback provided on the medium term study scope

High level theme	CAISO Response
The ISO should leverage existing information, and coordinate with the CPUC when applicable, rather than send a survey	Preliminary review of the past monthly showings indicated that the pool of shown resources vary year over year. Requesting information from the LSEs is to receive modeling inputs.
Concerned that the modeling results will be used for backstop	The effort is intended to provide insights and data to stakeholders
Consider possible retirements and assumptions for future resource development	Requesting annual information is to represent the evolving portfolio for the entire ISO BA (both resource additions and retirements)
Questions if the data will only include providing the annual peak month instead of providing 12 months of data	To reduce complexity of survey and modeling – we will assume the peak month showings as the available portfolio

Survey: Adjusting based on stakeholder feedback, CAISO could engage with LSEs to collect study data

- Short term survey:
  - requests non-binding 100% soft showings for the year-ahead,
  - responses will be used to determine the default PRM,
  - reported on an aggregate basis

- Mid-term and long-term simulation models and stochastic profiles will be posted on the website

For discussion - CAISO could survey Load Serving Entities (LSE's) to provide projected RA showings, projected RA contracts, and planning information

For the year ahead, monthly projected RA showings

Summary	January	February	March	April	May	June	July	August	September	October	November	December
Monthly Peak Load (MW)												
PRM (%)												
Reserve requirement (NQC Capacity MW)												
yes, if	sum >=requirement											
CAISO Resource ID	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
Resource1												
Resource2												
Resource3												
Resource4												
Resource5												
Resource6												
Resource7												

Example

Mid-term survey - for discussion

- Information CAISO may need –
  - projected estimates of contract capacity including incremental new additions and retirement assumptions.
  - CAISO resource IDs and queue numbers for new resource additions.

Summary	2025	2026	2027
Annual Peak Load (MW)			
PRM (%)			
Total contracted capacity for peak month (MW)			
	yes, if sum >=requirement		

Example

New RA from authorized procurement orders

Resource ID	CAISO queue number	Resource Name	Installed Capacity	COD	Fuel Type	NQC	Deliverabililty	Location	Area
Resource1									
Resource2									
Resource3									
Resource4									
Resource5									

NEXT STEPS

Next steps

- Next working group meeting: February 27 (hybrid)
- Please submit written comments on the February 13th working group meeting by Tuesday, February 27th, through the ISO's commenting tool using the link on the working group webpage: https//stakeholdercenter.caiso.com/Comments/MyOrgComments
- Please contact Jeff McDonald (jmcdonald@ceadvisors.com) to indicate if you would like to present, the topic you would like to present on and, how this topic relates to your proposed problem statement.

Proposed Schedule Through March 2024

Date	Topics
February 27 (hybrid)	• Review modeling overall • Deep dive: planned and forced outage and availability incentives • Continued discussion of problem statement topics • Action plan discussion
March 13 (hybrid)	• Deep dive: backstop processes • Panel discussion: backstop measures • Continued discussion of problem statement topics

Proposal for Path Forward

1. ***Maturity of an issue***
   - The issue has been presented and discussed, comments and edits to the problem statement by participants received, presentations provided from CAISO staff and others, and panel discussion has occurred.
   - The final problem statement is clearly defined with discussion supporting the source and impact of the problem.
2. ***Stakeholder input to move the problem forward***
   - A poll will be taken of participants to understand if there is opposition.
   - Written comments with feedback on what needs to be clarified in order to move forward to the next step.
3. ***Action Plan for promoted problem statement(s)***
   - An Action Plan will be drafted for problems that will advance, with opportunity for members to provide input on the draft.

Note: The working group process is the first stage of a potential market enhancement. There are many opportunities in the initiative process for stakeholders to provide input on any issue under consideration.